

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-217631

(43)Date of publication of application : 10.08.2001

(51)Int.Cl.

H01Q 1/38

H01Q 5/00

(21)Application number : 2000-027633

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(22)Date of filing : 04.02.2000

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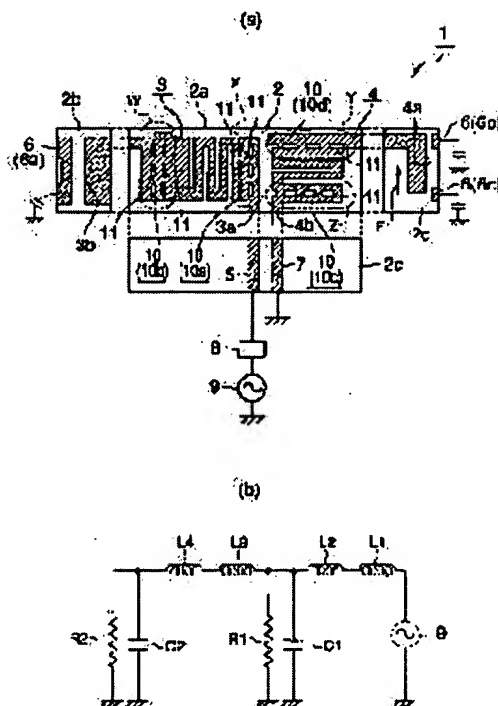
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(54) SURFACE-MOUNTED ANTENNA AND ITS ADJUSTING METHOD, AND COMMUNICATION DEVICE EQUIPPED WITH SURFACE-MOUNTED TYPE ANTENNA

(57)Abstract:

PROBLEM TO BE SOLVED: To facilitate frequency adjustment.

SOLUTION: On the surface of a dielectric base body 2, a feeding radiation electrode 3 and a parasitic radiation electrode 4 are arranged adjacent at an interval to create a multi-resonance state in both basic mode and higher mode. A correction pattern 10 for a series inductance component is formed in maximum resonance current areas of the basic mode and higher mode on the current paths of the feeding radiation electrode 3 and the parasitic radiation electrode 4. For frequency adjustment, the correction pattern 10 formed in the maximum resonance current area of an object mode to be adjusted is cut, to vary the inductance component of the pattern 10 and thus vary the electrical length, thereby adjusting the resonance frequency of the frequency adjustment object to a set frequency. At this time, the resonance frequency of the other mode does not vary. Thus, the frequency adjustment is easily and precisely completed in a short time.



LEGAL STATUS

[Date of request for examination] 09.02.2001
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the
examiner's decision of rejection or application
converted registration]
[Date of final disposal for application]
[Patent number] 3528737
[Date of registration] 05.03.2004
[Number of appeal against examiner's decision of
rejection]
[Date of requesting appeal against examiner's
decision of rejection]
[Date of extinction of right]

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の直列インダクタンス成分の修正用パターンと成しており、この直列インダクタンス成分の修正用パターンにはインダクタンス成分を切削により段階的に変化させて共振周波数を設定の周波数に向けて段階的に変化させる手段が設けられていることを特徴とした請求項9記載の表面実装型アンテナ。

【請求項11】 請求項9又は請求項10記載の表面実装型アンテナを備えていることを特徴とした通信装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、携帯型電話機等の通信装置に内蔵される表面実装型アンテナおよびその周波数調整方法および表面実装型アンテナを備えた通信装置に関するものである。

【0002】

【従来の技術】携帯型電話機等の通信装置に内蔵される表面実装型アンテナとして、近年、通信装置の小型化の観点から、1素子で互いに異なる複数の周波数帯域の信号（電波）の送受信が可能なのが要求されている。本発明者は、その要求に応えるべく、マルチバンド対応・複共振タイプの表面実装型アンテナを提案している。この提案のマルチバンド対応・複共振タイプの表面実装型アンテナは、誘電体基体の表面に給電放射電極と無給電放射電極を互いに間隔を介して配設して成るものである。上記無給電放射電極は給電放射電極の基本モードの共振波（基本波）と高次モードの共振波（高調波）の一方あるいは両方に複共振するように設計されている。

【0003】なお、この明細書では、設定されている複数の共振モードのうち、最低の共振周波数を持つものを基本モードと述べ、また、それよりも高い共振周波数を持つものを高次モードと述べている。さらに、高次モードの中でも、共振周波数が低いモードから順に、2次モード、3次モードという如く、区別して述べる場合もある。

【0004】上記誘電体基体の表面に給電放射電極を形成しただけでは、基本モードあるいは高次モードの信号送受信の周波数帯域の幅が要求される帯域幅よりも狭いことがあるが、上記提案の表面実装型アンテナでは、給電放射電極だけでなく、無給電放射電極を設けて基本モードあるいは高次モードで複共振状態を作り出し、これにより、周波数帯域の広帯域化を図っている。

【0005】

【発明が解決しようとする課題】ところで、そのような提案のマルチバンド対応・複共振タイプの表面実装型アンテナにおいて、上記給電放射電極の基本モードの共振周波数や、高次モードの共振周波数や、無給電放射電極の複共振のモードの共振周波数が加工精度の問題によって設定の周波数からずれる場合がある。そのような場合には、例えば、給電放射電極あるいは無給電放射電極を部分的に切削して（トリミングして）、そのずれている

共振周波数を設定の周波数に合わせる周波数調整を行うことが望ましい。

【0006】しかしながら、上記のような提案のマルチバンド対応・複共振タイプの表面実装型アンテナに関する周波数調整手法は確立されておらず、従来の表面実装型アンテナの周波数調整手法を用いて周波数調整を行うと、次に示すような問題が生じる虞があった。

【0007】その問題とは、例えば、給電放射電極の部分的な切削を行って基本モードの共振周波数のずれを修正した場合に、基本モードの共振周波数は設定の周波数に一致させることはできたが、上記切削によって給電放射電極の高次モードの共振周波数が設定の周波数からずれてしまう問題等があり、給電放射電極の基本モードの共振周波数と、高次モードの共振周波数と、無給電放射電極の上記複共振のモードの共振周波数との全てを設定の周波数に精度良く合わせることは困難であった。

【0008】本発明は上記課題を解決するために成されたものであり、その目的は、マルチバンド対応・複共振タイプの表面実装型アンテナに好適な周波数調整手法を提案し、周波数調整を簡単かつ効率良く行うことができる表面実装型アンテナおよびその周波数調整方法および表面実装型アンテナを備えた通信装置を提供することにある。

【0009】

【課題を解決するための手段】上記目的を達成するために、この発明は次に示す構成をもって前記課題を解決する手段としている。すなわち、第1の発明の表面実装型アンテナの周波数調整方法は、誘電体基体の表面に給電放射電極と無給電放射電極が間隔を介し近隣配置されており、上記無給電放射電極は上記給電放射電極と複共振する構成を備えた表面実装型アンテナの周波数調整方法であって、上記給電放射電極は、該給電放射電極の電流経路に沿って、単位長さ当たりの電気長の短い領域と、電気長の長い領域とが交互に直列に設けられている構成と成し、この給電放射電極における電気長の長い領域には電気長の修正用パターンを共振周波数調整用のパターンとして形成しておき、給電放射電極の共振周波数が設定の周波数からずれているときには、上記電気長の修正用パターンを部分的に切削して上記共振周波数を設定の周波数に一致させる構成をもって前記課題を解決する手段としている。

【0010】第2の発明の表面実装型アンテナの周波数調整方法は、上記第1の発明の構成を備え、無給電放射電極は、単位長さ当たりの電気長の短い領域と、電気長の長い領域とが交互に直列に設けられている構成と成し、この無給電放射電極における電気長の長い領域には電気長の修正用パターンを共振周波数調整用のパターンとして形成しておき、無給電放射電極の共振周波数が設定の周波数からずれているときには、上記電気長の修正用パターンを部分的に切削して上記共振周波数を設定の

用パターン（電気長の修正用パターン）を形成することによって周波数調整が容易となる。つまり、給電放射電極の基本モードの共振周波数が設定の周波数からずれている場合には、基本モードの最大共振電流領域に形成されている直列インダクタンス成分の修正用パターンを部分的に切削し、これにより、その修正用パターンのインダクタンス成分を変化させて電気長を修正して基本モードの共振周波数を設定の周波数に一致させる。

【0022】この際、上記の如く給電放射電極の部分的な切削を行っても、その切削による影響は給電放射電極の高次モードの共振周波数には及ばない。すなわち、基本モードの共振周波数と高次モードの共振周波数とを独立させた状態で周波数調整を行うことができることとなる。

【0023】給電放射電極の高次モードの共振周波数を調整する場合や、無給電放射電極の複共振のモードの共振周波数を調整する場合にも、上記同様に、給電放射電極あるいは無給電放射電極の周波数調整対象のモードの最大共振電流領域に形成されている直列インダクタンス成分の修正用パターンを部分的に切削して、そのパターンのインダクタンス成分を変化させて電気長を修正することにより、周波数調整対象の共振周波数を設定の周波数に一致させる。この際にも、周波数調整対象の共振周波数と他の共振周波数とを独立させた状態で周波数調整を行うことができる。

【0024】上記のように、共振周波数調整用のパターンを形成するので、周波数調整を行う際に好適な切削位置が明確となる。その上、その共振周波数調整用のパターンを給電放射電極あるいは無給電放射電極の電流経路上における各モードの最大共振電流領域に形成することによって、周波数調整対象のモードの共振周波数調整を行う際に、他のモードの共振周波数に悪影響を与えずに、周波数調整対象の共振周波数を設定の周波数に一致させることができる。したがって、表面実装型アンテナの周波数調整を簡単かつ効率的に、しかも、精度良く行うことができることとなる。

【0025】

【発明の実施の形態】以下に、この発明に係る実施形態例を図面に基づいて説明する。

【0026】図1(a)にはこの発明に係る第1の実施形態例の表面実装型アンテナが模式的に示されている。この図1(a)に示す表面実装型アンテナ1は誘電体基体2の表面に給電放射電極3と無給電放射電極4が互いに間隔を介して近隣配置されて成るマルチバンド対応・複共振タイプで、かつ、非グランド実装タイプの直接励振入/4共振型のものである。なお、図1(a)では、誘電体基体2の上面2aと側面2b、2c、2dの各表面形態が展開状態で図示されている。

【0027】この図1(a)に示すように、誘電体基体2の上面2aから側面2bに渡って給電放射電極3が形

成され、また、上記上面2aには給電放射電極3よりも図の右側に間隔を介して無給電放射電極4が形成されている。さらに、誘電体基体2の側面2cには給電端子5が形成されている。この給電端子5の一端側は底面側に回り込み、他端側は上記給電放射電極3の一端側3aに連通接続されている。この給電放射電極3の他端側3bは開放端と成している。

【0028】さらに、誘電体基体2の側面2bには上記給電放射電極3の開放端3bと間隔を介して固定電極6aが対向配置されている。さらに、誘電体基体2の側面2dには無給電放射電極4の開放端4a側が上面2aから伸長形成されると共に、この開放端4aに間隔を介して固定電極6b、6cが対向配置されている。さらにまた、誘電体基体2の側面2cにはグランド短絡端子7が上記給電端子5と間隔を介して隣接形成されており、このグランド短絡端子7の一端側は上記無給電放射電極4の端部4b側に連通接続され、他端側は底面側に回り込んでいる。

【0029】この第1の実施形態例では、上記給電放射電極3は図2(c)の点線Aに示すようなリターンロス特性を有し、また、無給電放射電極4は図2(c)の破線Bに示すようなリターンロス特性を有し、表面実装型アンテナ1として、上記リターンロス特性AとBを合成した図2(c)の実線Cに示すようなリターンロス特性を持つことができるように設計されている。

【0030】つまり、この第1の実施形態例では、上記給電放射電極3は設定の基本モードの共振周波数 f_1 および高次モード（ここでは2次モード）の共振周波数 f_2 でもって共振するように設計されている。また、無給電放射電極4は基本モードと高次モードの両方が複共振のモードと成しており、この無給電放射電極4の基本モードの共振波が給電放射電極3の基本モードの共振波と複共振するために、無給電放射電極4の基本モードの共振周波数 f_1' は給電放射電極3の基本モードの共振周波数 f_1 の近傍の周波数に、かつ、無給電放射電極4の高次モード（2次モード）の共振波が給電放射電極3の高次モード（2次モード）の共振波と複共振するために、無給電放射電極4の高次モードの共振周波数 f_2' は給電放射電極3の高次モードの共振周波数 f_2 の近傍の周波数となるように設計されている。

【0031】上記のように、給電放射電極3と無給電放射電極4が設計されることによって、図2(c)に示すように、基本モードと高次モードの両方のモードで複共振状態が作り出されて、基本モードと高次モードの両方における信号送受信の周波数帯域の広帯域化が図られている。

【0032】ところで、上記表面実装型アンテナ1は通信装置の回路基板に実装されて、給電端子5が回路基板の信号供給源9に整合回路8を介して導通接続される。なお、上記整合回路8は通信装置の回路基板上に外部的

直列インダクタンス成分の修正用パターン10aにおける領域a1、領域a2、領域a3を順に段階的に切削除去していく（あるいは、領域a1'、領域a2'、領域a3'を順に段階的に切削除去していく）という如く、ミアンダ状のパターンを形作るように切り込みを形成する方向に上記修正用パターン10を部分的に切削して該修正用パターン10のインダクタンス成分を段階的に高めて（電気長を段階的に長くして）、基本モードの共振周波数 f_1 を段階的に設定の周波数に向けて下げていく。なお、この第1の実施形態例では、図4に示すように、直列インダクタンス成分の修正用パターン10には周波数調整の際の切削の開始位置および切削方向を示すための切り欠き12が形成されている。この切り欠き12によって、周波数調整の作業者が切削の順番を誤るのを防止することができ、適切な周波数調整作業を行うことができることとなる。

【0044】また、図4の点線矢印Eに示す方向に、直列インダクタンス成分の修正用パターン10aを部分的に切削して電流経路を細くしていき、これにより、直列インダクタンス成分の修正用パターン10aのインダクタンス成分を高めて電気長を長くして、基本モードの共振周波数 f_1 を設定の周波数に向けて下げていくようにしてもよい。

【0045】上記のように直列インダクタンス成分の修正用パターン10aのインダクタンス成分を局所的に高めて電気長を長くしていき、基本モードの共振周波数 f_1 を下げて設定の周波数に一致させる。この基本モードの共振周波数 f_1 の周波数調整の際には、その周波数調整の影響は高次モードの共振周波数に殆ど及ばない。このため、高次モードの共振周波数 f_2 を変化させずに、基本モードの共振周波数 f_1 を高次モードの共振周波数 f_2 と独立させた状態で上記の如く周波数調整を行うことができる。

【0046】給電放射電極3の2次モードの共振周波数 f_2 や無給電放射電極4の基本モードの共振周波数 f_1' や2次モードの共振周波数 f_2' が設定の周波数よりも高い方向にずれているときには、上記同様にして、周波数調整対象のモードの最大共振電流領域P（つまり領域W又はZ又はY）に形成されている直列インダクタンス成分の修正用パターン10b又は10c又は10dを部分的に切削して、その修正用パターン10の直列インダクタンス成分を局所的に高めて電気長を長くし、これにより、周波数調整対象の共振周波数を設定の周波数に向けて下げていく。このようにして、周波数調整対象の共振周波数を設定の周波数に一致させることができる。

【0047】上記共振周波数 f_2 、 f_1' 、 f_2' の周波数調整の場合にも、上記基本モードの共振周波数 f_1 の周波数調整と同様に、各モードの共振周波数を他のモードの共振周波数とは独立させた状態で調整することが

できる。

【0048】なお、もちろん、直列インダクタンス成分の修正用パターン10b、10c、10dにも、上記直列インダクタンス成分の修正用パターン10aに形成されている切り欠き12と同様の切り欠きが形成されている。

【0049】また、給電放射電極3の基本モードと2次モードの各共振周波数 f_1 、 f_2 が共に設定の周波数よりも低い方向にずれているときには、給電放射電極3の開放端3bを切削していき、該開放端3bと固定電極6a間の間隔を広げて開放端3bと固定電極6a間の容量を小さくしていくことで、開放端3bとグランド間の容量を小さくしていき、上記基本モードと2次モードの各共振周波数 f_1 、 f_2 を両方共に設定の周波数に向けて高める。

【0050】上記同様に、無給電放射電極4の基本モードと2次モードの各共振周波数 f_1' 、 f_2' が共に設定の周波数よりも低い方向にずれているときには、無給電放射電極4の開放端4aを例えば図1(a)に示す矢印Fの方向に切削して無給電放射電極4を短くしていくことによって、開放端4aと固定電極6b、6c間の容量を小さくして開放端4aとグランド間の容量を小さくし、これにより、無給電放射電極4の基本モードと2次モードの各共振周波数 f_1' 、 f_2' を両方共に設定の周波数に向けて高める。なお、このように、給電放射電極3あるいは無給電放射電極4の開放端3b、4aは容量調整用パターンとして機能するものである。

【0051】上記のような周波数調整を行って、給電放射電極3と無給電放射電極4の各モードの共振周波数 f_1 、 f_1' 、 f_2 、 f_2' を全て設定の周波数にほぼ一致させることができる。

【0052】この第1の実施形態例によれば、給電放射電極3の電流経路上における基本モードの最大共振電流領域P（領域X）と高次モードの最大共振電流領域P（領域W）と、無給電放射電極4の電流経路上における基本モードの最大共振電流領域P（領域Z）と高次モードの最大共振電流領域P（領域Y）にはそれぞれ直列インダクタンス成分の修正用パターン（電気長の修正用パターン）10を共振周波数調整用のパターンとして形成した。この構成を備えたことによって、給電放射電極3の基本モードの共振周波数 f_1 や高次モードの共振周波数 f_2 や無給電放射電極4の基本モードの共振周波数 f_1' や高次モードの共振周波数 f_2' が加工精度の問題によって設定の周波数からずれている際には、その周波数調整対象のモードの最大共振電流領域Pに形成されている直列インダクタンス成分の修正用パターン10を部分的に切削して該修正用パターン10の直列インダクタンス成分を局所的に変化させて電気長を変化させることと、開放端容量を小さくし共振周波数を上昇させる手法とを併用し、これにより、周波数調整対象のモードの共

【0065】また、給電放射電極3の開放端3bあるいは無給電放射電極4の開放端4aを切削して開放端3b、4aとグランド間容量を下げることによって、給電放射電極3の基本モードと高次モードの両方の共振周波数 f_1 、 f_2 を、あるいは、無給電放射電極4の基本モードと高次モードの両方の共振周波数 f_1' 、 f_2' をそれぞれ同時に高めることができる。

【0066】この第2の実施形態例においても、上記第1の実施形態例と同様の優れた効果を奏することができる。

【0067】以下に、第3の実施形態例を説明する。なお、この第3の実施形態例の説明において、前記各実施形態例と同一構成部分には同一符号を付し、その共通部分の重複説明は省略する。

【0068】図6には表面実装型アンテナの第3の実施形態例が示されている。この図6においても、前記図1や図5と同様に、誘電体基体2の上面2aと側面2b、2c、2dの各表面形態が展開状態により示されている。

【0069】この第3の実施形態例に示す表面実装型アンテナ1は非グランド実装タイプの直接励振型のもので、図6に示すように、誘電体基体2の表面に給電放射電極3と2個の無給電放射電極4A、4Bとが互いに間隔を介して形成されて成るものである。上記給電放射電極3は前記図1に示す給電放射電極3とほぼ同様な構成を有し、上記無給電放射電極4A、4Bは誘電体基体2の上面2aにおける給電放射電極3よりも図の右側に互いに間隔を介して形成されている。

【0070】上記無給電放射電極4A、4Bの各基本モードの共振周波数 f_1' 、 f_1'' は互いに僅かに異なり、かつ、給電放射電極3の基本モードの共振周波数 f_1 の近傍の周波数と成しており、上記無給電放射電極4A、4Bの各基本モードの共振波は給電放射電極3の基本モードの共振波と3重の複共振状態を作り出す。また、同様に、上記無給電放射電極4A、4Bの各高次モードの共振周波数 f_2' 、 f_2'' は互いに僅かに異なり、かつ、給電放射電極3の高次モードの共振周波数 f_2 の近傍の周波数と成しており、上記無給電放射電極4A、4Bの各高次モードの共振波は給電放射電極3の高次モードの共振波と3重の複共振状態を作り出す。このように、3重の複共振状態を作り出すことにより、基本モードと高次モードの信号送受信の周波数帯域のより一層の広帯域化を図ることができる。

【0071】上記無給電放射電極4A、4Bの各一端側は側面2cに形成されたグランド短絡端子7に共通に連通接続され、各無給電放射電極4A、4Bの他端側はそれぞれ開放端と成している。上記各無給電放射電極4A、4Bでは、グランド短絡端子7に連通する一端側から開放端に向けて電流が流れる構成と成っており、各無給電放射電極4A、4Bの電流経路上における基本モー

ドの最大共振電流領域 $P(P_1)$ である領域 Z 、 Z' と、高次モードの最大共振電流領域 $P(P_2)$ である領域 Y 、 Y' とはそれぞれ共振周波数調整用のパターンである直列インダクタンス成分の修正用パターン（電気長の修正用パターン）10が形成されている。

【0072】この第3の実施形態例においても、給電放射電極3と無給電放射電極4A、4Bの各電流経路上に上記各実施形態例と同様な直列インダクタンス成分の修正用パターン（電気長の修正用パターン）10を形成したので、上記各実施形態例と同様に、給電放射電極3又は無給電放射電極4A又は無給電放射電極4Bにおける周波数調整対象のモードの最大共振電流領域 P に形成されている直列インダクタンス成分の修正用パターン10を切削して該修正用パターン10のインダクタンス成分を変化させて電気長を長くすることによって、周波数調整対象の共振周波数を他のモードの共振周波数と独立させた状態で設定の周波数に一致させることができる。

【0073】また、給電放射電極3、無給電放射電極4A、4Bのそれぞれの基本モードと高次モードの各共振周波数が共に設定の周波数よりも低い場合には周波数調整対象の給電放射電極3、無給電放射電極4A、4Bの開放端を切削して基本モードと高次モードの各共振周波数を両方共に同時に高めて設定の周波数に一致させることができる。

【0074】この第3の実施形態例においても、前記各実施形態例と同様の優れた効果を奏することができる。

【0075】以下に、第4の実施形態例を説明する。この第4の実施形態例では、通信装置の一例を示す。この第4の実施形態例における通信装置は、図7に示すように、携帯型電話機であり、この携帯型電話機20のケース21内には回路基板22が内蔵されている。この回路基板22には、図7に示すように、信号供給源である送信回路23と受信回路24と送受信切り換え回路25が形成されている。

【0076】この第4の実施形態例の通信装置において特徴的なことは、上記回路基板22に上記各実施形態例に示した特有な構成を備えた表面実装型アンテナ1が実装されていることである。この表面実装型アンテナ1は、上記送信回路23および受信回路24に送受信切り換え回路25を介して導通接続されている。この携帯型電話機20においては、上記送受信切り換え回路25の切り換え動作によって、信号の送受信動作が円滑に行われるものである。

【0077】この第4の実施形態例によれば、携帯型電話機20に上記各実施形態例に示したような複共振タイプの表面実装型アンテナを装備したので、信号送受信の周波数帯域を広帯域化することができ、しかも、その表面実装型アンテナ1は、周波数調整によって給電放射電極3や無給電放射電極4の各共振周波数が設定の周波数にほぼ一致していることから、アンテナ特性の信頼性が

放射電極は電流経路の一端側が開放端と成し、無給電放射電極の基本モードと高次モードの各共振周波数が共に設定の周波数よりも低い場合に、上記給電放射電極あるいは無給電放射電極の開放端を切削して開放端とグランド間の容量を小さくして給電放射電極あるいは無給電放射電極の基本モードと高次モードの各共振周波数を両方共に設定の周波数に向けて高めるものにあつては、給電放射電極あるいは無給電放射電極の開放端を切削するだけで、基本モードと高次モードの両方の共振周波数を設定の周波数に向けて変化させることができるので、効率良く周波数調整を行うことができることとなる。

【0089】直列インダクタンス成分の修正用パターンを部分的に切削して該修正用パターンのインダクタンス成分を段階的に変化させる手段が設けられているものにあつては、その手段を利用して周波数調整対象の共振周波数を段階的に設定の周波数に変化させることができる。このような周波数調整を行う際には、パターンの切削量を経験に基づいて加減するというような面倒がなくなるので、より一層簡単に周波数調整を行うことができ、表面実装型アンテナの量産性をより一層向上させることができる。

【0090】通信装置に、上記特有な周波数調整が可能な表面実装型アンテナを設けることにより、アンテナ特性の信頼性の高い通信装置を安価で提供することができることとなる。

【図面の簡単な説明】

【図1】本発明に係る表面実装型アンテナの第1の実施形態例を示す説明図である。

【図2】表面実装型アンテナの周波数特性の例を示すグラフである。

【図3】給電放射電極、無給電放射電極の電流経路における電流分布と電圧分布をモード毎に示すグラフである。

【図4】図1に示す表面実装型アンテナの周波数調整を行う際に共振周波数調整用パターンである直列インダクタンス成分の修正用パターンの切削例を説明するための図である。

【図5】第2の実施形態例を示す説明図である。

【図6】第3の実施形態例を示す説明図である。

【図7】本発明に係る通信装置の一例を示すモデル図である。

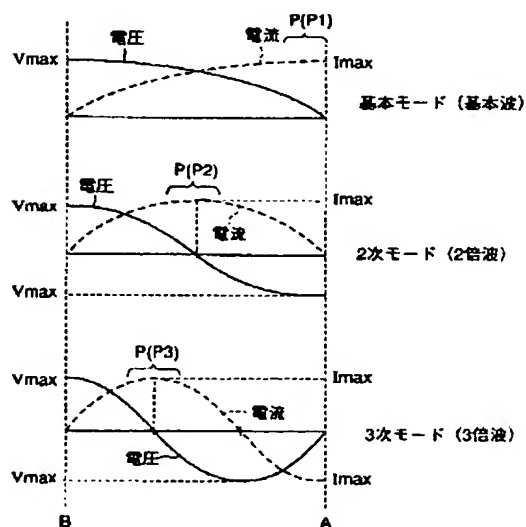
【図8】直列インダクタンス成分の修正用パターンのその他の実施形態例を示す説明図である。

【図9】さらに、直列インダクタンス成分の修正用パターンのその他の実施形態例を示す説明図である。

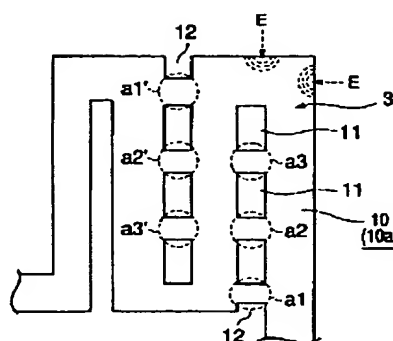
【符号の説明】

- 1 表面実装型アンテナ
- 2 誘電体基体
- 3 給電放射電極
- 4 無給電放射電極
- 5 給電端子
- 7 グランド短絡端子
- 10 直列インダクタンス成分の修正用パターン
- 11 穴パターン
- 20 携帯型電話機

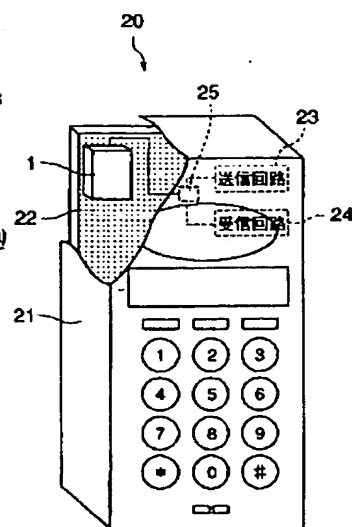
【図3】



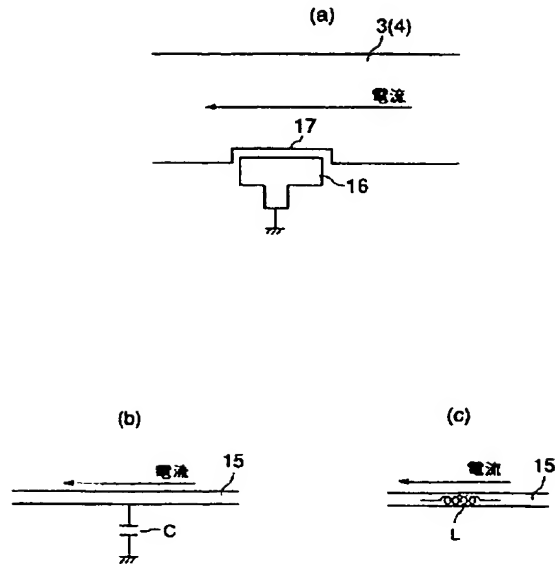
【図4】



【図7】



【図9】



フロントページの続き

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Fターム(参考) 5J046 AA04 AB13 PA01

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CLAIMS

[Claim(s)]

[Claim 1] Neighboring arrangement of a feed radiation electrode and the non-supplied electric power radiation electrode is carried out through spacing on the front face of a dielectric base. The above-mentioned non-supplied electric power radiation electrode is the frequency regulation approach of the surface mount mold antenna equipped with the configuration which double-resonates with the above-mentioned feed radiation electrode. The above-mentioned feed radiation electrode The current path of this feed radiation electrode is met. The short field of the electric length of the hit by unit length, Accomplish with the configuration that electric merit's long field is established in the serial by turns, and the pattern for correction of electric length is formed in electric merit's long field in this feed radiation electrode as a pattern for resonance frequency adjustment. The frequency regulation approach of the surface mount mold antenna characterized by cutting selectively the above-mentioned electric merit's pattern for correction, and making it in agreement with the frequency of setting out of the above-mentioned resonance frequency when the resonance frequency of a feed radiation electrode has shifted from the frequency of setting out.

[Claim 2] A non-supplied electric power radiation electrode is accomplished with the configuration that the short field of the electric length of the hit by unit length and the long field of electric length are established in the serial by turns. The pattern for correction of electric length is formed in electric merit's long field in this non-supplied electric power radiation electrode as a pattern for resonance frequency adjustment. The frequency regulation approach of the surface mount mold antenna according to claim 1 characterized by cutting selectively the above-mentioned electric merit's pattern for correction, and making it in agreement with the frequency of setting out of the above-mentioned resonance frequency when the resonance frequency of a non-supplied electric power radiation electrode has shifted from the frequency of setting out.

[Claim 3] Neighboring arrangement of a feed radiation electrode and the non-supplied electric power radiation electrode is carried out through spacing on the front face of a dielectric base. The above-mentioned non-supplied electric power radiation electrode is the frequency regulation approach of the surface mount mold antenna equipped with the resonance wave in at least one mode in the basic mode of the above-mentioned feed radiation electrode, and the higher mode, and the configuration which double-resonates. On the current path of the above-mentioned feed radiation electrode The maximum current section from which the resonance current of the basic mode which can be set serves as extremal value The maximum current section from which the resonance current in the maximum resonance current field of the higher mode containing the maximum current section from which the maximum resonance current field of a basic mode and the resonance current of the higher mode to include serve as extremal value, and the mode the above-mentioned double resonance on the current path of the above-mentioned non-supplied electric power radiation electrode serves as extremal value The pattern for correction of a serial inductance component is formed or more in one of the maximum resonance current fields to include. When the resonance frequency in the mode with the maximum resonance current field in which the pattern for correction of the above-mentioned serial inductance component is formed has shifted from the frequency of setting out The frequency regulation approach of the surface mount mold antenna characterized by cutting selectively the pattern for correction of the serial inductance component, and making it in agreement with the frequency of setting out of the resonance frequency for [above-mentioned] frequency regulation.

[Claim 4] The pattern for correction of a serial inductance component is the frequency regulation approach of the surface mount mold antenna according to claim 3 characterized by for two or more hole patterns carrying out contiguity

arrangement, and constituting them through spacing.

[Claim 5] The end side of a current path has accomplished the feed radiation electrode with the open end. The resonance frequency of the basic mode of this feed radiation electrode and the resonance frequency of the higher mode when lower than both the frequencies of setting out. The frequency regulation approach of the surface mount mold antenna according to claim 3 or 4 which cut the open end of the above-mentioned feed radiation electrode, made small capacity between this open end and a gland, and was characterized by turning and raising each resonance frequency of both of the basic mode of a feed radiation electrode, and the higher mode to the frequency of setting out.

[Claim 6] The end side of a current path has accomplished the feed radiation electrode with the open end, and the pattern for capacity adjustment for adjusting the capacity between this open end and a gland to the open end side of this feed radiation electrode is formed. The resonance frequency of the basic mode of a feed radiation electrode and the resonance frequency of the higher mode when lower than both the frequencies of setting out. Cut selectively the pattern for capacity adjustment by the side of the open end of the above-mentioned feed radiation electrode, and capacity between an open end and a gland is made small. The frequency regulation approach of the surface mount mold antenna according to claim 3 or 4 characterized by turning and raising each resonance frequency of both of the basic mode of a feed radiation electrode, and the higher mode to the frequency of setting out.

[Claim 7] It resonates that the higher mode which double-resonates on the resonance wave of the basic mode which double-resonates on the resonance wave of the basic mode of a feed radiation electrode, and the higher mode of a feed radiation electrode is also for a non-supplied electric power radiation electrode. The end side of a current path has accomplished with the open end. The resonance frequency of the basic mode of this non-supplied electric power radiation electrode and the resonance frequency of the higher mode and when lower than both the frequencies of setting out. Cut the open end of the above-mentioned non-supplied electric power radiation electrode, and capacity between this open end and a gland is made small. The frequency regulation approach of claim 3 characterized by turning and raising each resonance frequency of both of the basic mode of a non-supplied electric power radiation electrode, and the higher mode to the frequency of setting out, or a surface mount mold antenna according to claim 4, 5, or 6.

[Claim 8] The frequency regulation approach of the surface mount mold antenna any one publication of claim 3 characterized by forming a means to change an inductance component gradually by cut in the pattern for correction of a serial inductance component, and making it change to it gradually towards the frequency of setting out of the resonance frequency for frequency regulation using this means thru/or claim 7.

[Claim 9] In the front face of a dielectric base, neighboring arrangement of a feed radiation electrode and the non-supplied electric power radiation electrode is carried out through spacing. The above-mentioned non-supplied electric power radiation electrode is the surface mount mold antenna equipped with the resonance wave in at least one mode in the basic mode of the above-mentioned feed radiation electrode, and the higher mode, and the configuration which double-resonates. The pattern for resonance frequency adjustment of the basic mode of the above-mentioned feed radiation electrode. The surface mount mold antenna characterized by forming at least one or more patterns in the pattern for resonance frequency adjustment of the higher mode of a feed radiation electrode, and the pattern for resonance frequency adjustment in the mode the above-mentioned double resonance in the above-mentioned non-supplied electric power radiation electrode.

[Claim 10] The pattern for resonance frequency adjustment in each mode was formed in the maximum resonance current field containing the maximum current section from which the resonance current in the mode in which it corresponds on the current path in a feed radiation electrode or a non-supplied electric power radiation electrode, respectively serves as extremal value, and is accomplished with the pattern for correction of the serial inductance component of this field. The surface mount mold antenna according to claim 9 characterized by establishing a means to change an inductance component to the pattern for correction of this serial inductance component gradually by cut, and to make it change gradually towards the frequency of setting out of resonance frequency.

[Claim 11] The communication device characterized by having the surface mount mold antenna according to claim 9 or 10.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the communication device equipped with the surface mount mold antenna built in communication devices, such as pocket mold telephone, its frequency regulation approach, and a surface mount mold antenna.

[0002]

[Description of the Prior Art] As a surface mount mold antenna built in communication devices, such as pocket mold telephone, the thing which can transmit and receive the signal (electric wave) of two or more mutually different frequency bands is demanded by one element from a viewpoint of a miniaturization of a communication device in recent years. this invention person has proposed the - double resonance type surface mount mold antenna corresponding to a multi-band so that he may meet the demand. The - double resonance type surface mount mold antenna corresponding to a multi-band of this proposal arranges a feed radiation electrode and the non-supplied electric power radiation electrode of each other in the front face of a dielectric base through spacing, and grows into it. on the other hand, the above-mentioned non-supplied electric power radiation electrode has the resonance wave (fundamental wave) of the basic mode of a feed radiation electrode, and the resonance wave (higher harmonic) of the higher mode -- it is -- it is designed so that it may double-resonate with both.

[0003] In addition, on these descriptions, what describes what has the minimum resonance frequency among two or more resonance modes set up as a basic mode, and has resonance frequency higher than it is described as the higher mode. Furthermore, it may distinguish and state like the secondary mode and the 3rd mode sequentially from the mode in which resonance frequency is low, also in the higher mode.

[0004] Although it is sometimes narrower than the bandwidth as which the width of face of the frequency band of signal transmission and reception of a basic mode or the higher mode is required only by forming a feed radiation electrode in the front face of the above-mentioned dielectric base, with the surface mount mold antenna of the above-mentioned proposal, not only a feed radiation electrode but a non-supplied electric power radiation electrode is prepared, the double resonance state is made by the basic mode or the higher mode, and, thereby, broadband-ization of a frequency band is in drawing.

[0005]

[Problem(s) to be Solved by the Invention] By the way, in the - double resonance type surface mount mold antenna corresponding to a multi-band of such a proposal, the resonance frequency of the basic mode of the above-mentioned feed radiation electrode, the resonance frequency of the higher mode, and the resonance frequency in the mode double resonance of a non-supplied electric power radiation electrode may shift from the frequency of setting out according to the problem of process tolerance. In such a case, it is desirable to perform frequency regulation which cuts selectively a feed radiation electrode or a non-supplied electric power radiation electrode (trimming), and sets it by the frequency of setting out of the resonance frequency which has shifted, for example.

[0006] However, it was not established, but the frequency regulation technique about the - double resonance type surface mount mold antenna corresponding to a multi-band of the above proposals had a possibility that a problem as shown below might arise, when frequency regulation was performed using the frequency regulation technique of the conventional surface mount mold antenna.

[0007] Although the resonance frequency of a basic mode was able to be made in agreement with the problem in the

frequency of setting out when the partial cut of for example, a feed radiation electrode was performed and a gap of the resonance frequency of a basic mode was corrected There is a problem the resonance frequency of the higher mode of a feed radiation electrode shifts [problem] from the frequency of setting out by the above-mentioned cut. The resonance frequency of the basic mode of a feed radiation electrode, It was difficult to double with a precision sufficient in the frequency of setting out of all of the resonance frequency of the higher mode, and the resonance frequency in the mode of the above-mentioned double resonance of a non-supplied electric power radiation electrode.

[0008] Accomplishing this invention in order to solve the above-mentioned technical problem, the object proposes the suitable frequency regulation technique for the - double resonance type surface mount mold antenna corresponding to a multi-band, and is to offer the communication device equipped with the surface mount mold antenna which can perform frequency regulation simply and efficiently, its frequency regulation approach, and a surface mount mold antenna.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned object, this invention is taken as a means to solve said technical problem with the configuration shown below. Namely, the frequency regulation approach of the surface mount mold antenna the 1st invention Neighboring arrangement of a feed radiation electrode and the non-supplied electric power radiation electrode is carried out through spacing on the front face of a dielectric base. The above-mentioned non-supplied electric power radiation electrode is the frequency regulation approach of the surface mount mold antenna equipped with the configuration which double-resonates with the above-mentioned feed radiation electrode. The above-mentioned feed radiation electrode The current path of this feed radiation electrode is met. The short field of the electric length of the hit by unit length, Accomplish with the configuration that electric merit's long field is established in the serial by turns, and the pattern for correction of electric length is formed in electric merit's long field in this feed radiation electrode as a pattern for resonance frequency adjustment. When the resonance frequency of a feed radiation electrode has shifted from the frequency of setting out, it is considering as a means to solve said technical problem with the configuration which cuts selectively the above-mentioned electric merit's pattern for correction, and is made in agreement with the frequency of setting out of the above-mentioned resonance frequency.

[0010] The frequency regulation approach of the surface mount mold antenna the 2nd invention It has the configuration of invention of the above 1st. A non-supplied electric power radiation electrode It accomplishes with the configuration that the short field of the electric length of the hit by unit length and the long field of electric length are established in the serial by turns. The pattern for correction of electric length is formed in electric merit's long field in this non-supplied electric power radiation electrode as a pattern for resonance frequency adjustment. When the resonance frequency of a non-supplied electric power radiation electrode has shifted from the frequency of setting out, it constitutes cutting selectively the above-mentioned electric merit's pattern for correction, and making it in agreement with the frequency of setting out of the above-mentioned resonance frequency as a description.

[0011] The frequency regulation approach of the surface mount mold antenna the 3rd invention Neighboring arrangement of a feed radiation electrode and the non-supplied electric power radiation electrode is carried out through spacing on the front face of a dielectric base. The above-mentioned non-supplied electric power radiation electrode is the frequency regulation approach of the surface mount mold antenna equipped with the resonance wave in at least one mode in the basic mode of the above-mentioned feed radiation electrode, and the higher mode, and the configuration which double-resonates. On the current path of the above-mentioned feed radiation electrode The maximum current section from which the resonance current of the basic mode which can be set serves as extremal value The maximum current section from which the resonance current in the maximum resonance current field of the higher mode containing the maximum current section from which the maximum resonance current field of a basic mode and the resonance current of the higher mode to include serve as extremal value, and the mode the above-mentioned double resonance on the current path of the above-mentioned non-supplied electric power radiation electrode serves as extremal value The pattern for correction of a serial inductance component is formed or more in one of the maximum resonance current fields to include. When the resonance frequency in the mode with the maximum resonance current field in which the pattern for correction of the above-mentioned serial inductance component is formed has shifted from the frequency of setting out It constitutes cutting selectively the pattern for correction of the serial inductance component, and making it in agreement with the frequency of setting out of the resonance frequency for [above-mentioned] frequency regulation as a description.

[0012] The frequency regulation approach of the surface mount mold antenna the 4th invention is equipped with the configuration of invention of the above 3rd, and it constitutes as a description that two or more hole patterns carry out contiguity arrangement through spacing, and the pattern for correction of a serial inductance component is constituted.

[0013] The frequency regulation approach of the surface mount mold antenna the 5th invention Had the configuration of the above 3rd or the 4th invention, and the end side of a current path has accomplished the feed radiation electrode with the open end. The resonance frequency of the basic mode of this feed radiation electrode and the resonance frequency of the higher mode when lower than both the frequencies of setting out The open end of the above-mentioned feed radiation electrode is cut, capacity between this open end and a gland is made small, and it constitutes turning and raising each resonance frequency of both of the basic mode of a feed radiation electrode, and the higher mode to the frequency of setting out as a description.

[0014] The frequency regulation approach of the surface mount mold antenna the 6th invention Had the configuration of the above 3rd or the 4th invention, and the end side of a current path has accomplished the feed radiation electrode with the open end. The pattern for capacity adjustment for adjusting the capacity between this open end and a gland to the open end side of this feed radiation electrode is formed. The resonance frequency of the basic mode of a feed radiation electrode and the resonance frequency of the higher mode when lower than both the frequencies of setting out The pattern for capacity adjustment by the side of the open end of the above-mentioned feed radiation electrode is cut selectively, capacity between an open end and a gland is made small, and it constitutes turning and raising each resonance frequency of both of the basic mode of a feed radiation electrode, and the higher mode to the frequency of setting out as a description.

[0015] The frequency regulation approach of the surface mount mold antenna the 7th invention Have the configuration of the above 3rd, the 4th, the 5th, or the 6th invention, and it resonates that the higher mode which double-resonates on the resonance wave of the basic mode which double-resonates on the resonance wave of the basic mode of a feed radiation electrode, and the higher mode of a feed radiation electrode is also for a non-supplied electric power radiation electrode. The end side of a current path has accomplished with the open end. The resonance frequency of the basic mode of this non-supplied electric power radiation electrode and the resonance frequency of the higher mode and when lower than both the frequencies of setting out The open end of the above-mentioned non-supplied electric power radiation electrode is cut, capacity between this open end and a gland is made small, and it constitutes turning and raising each resonance frequency of both of the basic mode of a non-supplied electric power radiation electrode, and the higher mode to the frequency of setting out as a description.

[0016] The frequency regulation approach of the surface mount mold antenna the 8th invention is equipped with the configuration of any one invention of the above 3rd - the 7th invention, and establishes a means to change an inductance component to the pattern for correction of a serial inductance component gradually by cut, and it constitutes making it change gradually towards the frequency of setting out of the resonance frequency for frequency regulation using this means as a description.

[0017] In the front face of a dielectric base, as for the surface mount mold antenna of the 9th invention, neighboring arrangement of a feed radiation electrode and the non-supplied electric power radiation electrode is carried out through spacing. The above-mentioned non-supplied electric power radiation electrode is the surface mount mold antenna equipped with the resonance wave in at least one mode in the basic mode of the above-mentioned feed radiation electrode, and the higher mode, and the configuration which double-resonates. The pattern for resonance frequency adjustment of the basic mode of the above-mentioned feed radiation electrode It constitutes as a description that at least one or more patterns in the pattern for resonance frequency adjustment of the higher mode of a feed radiation electrode and the pattern for resonance frequency adjustment in the mode the above-mentioned double resonance in the above-mentioned non-supplied electric power radiation electrode are formed.

[0018] The surface mount mold antenna of the 10th invention is equipped with the configuration of invention of the above 9th. The pattern for resonance frequency adjustment in each mode was formed in the maximum resonance current field containing the maximum current section from which the resonance current in the mode in which it corresponds on the current path in a feed radiation electrode or a non-supplied electric power radiation electrode, respectively serves as extremal value, and is accomplished with the pattern for correction of the serial inductance component of this field. It constitutes as a description that a means to change an inductance component to the pattern for correction of this serial inductance component gradually by cut, and to make it change gradually towards the frequency of setting out of resonance frequency is established.

[0019] The communication device of the 11th invention is constituted considering having the surface mount mold antenna of the above 9th or the 10th invention as a description.

[0020] It sets to invention of the above-mentioned configuration, for example, the maximum resonance current field of the basic mode on the current path of a feed radiation electrode, the maximum resonance current field of the higher mode, and the maximum resonance current field in the mode double resonance of a non-supplied electric power radiation electrode constitute to electric merit's long field, respectively, and the pattern of a serial inductance component for correction, i.e., electric merit's pattern for correction, forms in each [these] electric merit's long field as a pattern for resonance-frequency adjustment, respectively.

[0021] Thus, frequency regulation becomes easy by forming the pattern for correction of a serial inductance component (electric merit's pattern for correction). That is, when the resonance frequency of the basic mode of a feed radiation electrode has shifted from the frequency of setting out, the pattern for correction of the serial inductance component currently formed in the maximum resonance current field of a basic mode is cut selectively, and thereby, the inductance component of the pattern for correction is changed, electric merit is corrected, and it is made in agreement with the frequency of setting out of the resonance frequency of a basic mode.

[0022] Under the present circumstances, even if it performs the partial cut of a feed radiation electrode like the above, the effect by that cut is less than the resonance frequency of the higher mode of a feed radiation electrode. That is, frequency regulation can be performed in the condition of having made the resonance frequency of a basic mode, and the resonance frequency of the higher mode becoming independent.

[0023] When adjusting the resonance frequency of the higher mode of a feed radiation electrode, or also when adjusting the resonance frequency in the mode double resonance of a non-supplied electric power radiation electrode The pattern for correction of the serial inductance component currently formed in the maximum resonance current field in the mode for [of a feed radiation electrode or a non-supplied electric power radiation electrode] frequency regulation is selectively cut like the above. By changing the inductance component of the pattern and correcting electric merit, it is made in agreement with the frequency of setting out of the resonance frequency for frequency regulation. Frequency regulation can be performed in the condition of having made the resonance frequency for frequency regulation, and other resonance frequency becoming independent also in this case.

[0024] As mentioned above, since the pattern for resonance frequency adjustment is formed, in case frequency regulation is performed, a suitable cut location becomes clear. In case resonance frequency adjustment in the mode for frequency regulation is performed by moreover forming the pattern for the resonance frequency adjustment in the maximum resonance current field in each mode on the current path of a feed radiation electrode or a non-supplied electric power radiation electrode, it can be made in agreement [without having an adverse effect on the resonance frequency in other modes] with the frequency of setting out of the resonance frequency for frequency regulation. Therefore, frequency regulation of a surface mount mold antenna can be performed with a precision simply and sufficient efficient moreover.

[0025]

[Embodiment of the Invention] Below, the example of an operation gestalt concerning this invention is explained based on a drawing.

[0026] The surface mount mold antenna of the 1st example of an operation gestalt concerning this invention is typically shown in drawing 1 (a). The surface mount mold antenna 1 shown in this drawing 1 (a) is - double resonance type corresponding to the multi-band with which neighboring arrangement is mutually carried out through spacing, and the feed radiation electrode 3 and the non-supplied electric power radiation electrode 4 grow into the front face of the dielectric base 2, and is the thing of non-grand mounting type direct excitation $\lambda/4$ resonance molds. In addition, in drawing 1 (a), top-face 2a of the dielectric base 2, side-face 2b, and each surface type voice (2c and 2d) are illustrated in the state of expansion.

[0027] As shown in this drawing 1 (a), the feed radiation electrode 3 is formed over top-face 2a of the dielectric base 2 to side-face 2b, and the non-supplied electric power radiation electrode 4 is formed in the right-hand side of drawing through spacing at above-mentioned top-face 2a rather than the feed radiation electrode 3. Furthermore, the feed terminal 5 is formed in side-face 2c of the dielectric base 2. Free passage connection of a surroundings lump side and the other end side is made by the end side of this feed terminal 5 at the base side at end side 3a of the above-mentioned feed radiation electrode 3. Other end side 3b of this feed radiation electrode 3 has accomplished with the open end.

[0028] Furthermore, opposite arrangement of the fixed electrode 6a is carried out at side-face 2b of the dielectric base 2

through open end 3b of the above-mentioned feed radiation electrode 3, and spacing. Furthermore, while expanding formation of the open end 4a side of the non-supplied electric power radiation electrode 4 is carried out from top-face 2a at 2d of side faces of the dielectric base 2, opposite arrangement of the fixed electrodes 6b and 6c is carried out through spacing at this open end 4a. Contiguity formation of the grand jumper 7 is carried out through the above-mentioned feed terminal 5 and spacing at side-face 2c of the dielectric base 2, free passage connection of the end side of this grand jumper 7 is made further again at the edge 4b side of the above-mentioned non-supplied electric power radiation electrode 4, and an other end side turns to a base side.

[0029] It has a return-loss property as shown in the dotted line A of drawing 2 (c), and a non-supplied electric power radiation electrode 4 has a return-loss property as shown in the broken line B of drawing 2 (c), and in this 1st example of an operation gestalt, the above-mentioned feed radiation electrode 3 is designed so that it may have a return-loss property as shown in the continuous line C of drawing 2 (c) which compounded the above-mentioned return-loss properties A and B as a surface mount mold antenna 1.

[0030] That is, in this 1st example of an operation gestalt, it is designed so that it may resonate that the above-mentioned feed radiation electrode 3 is also at the resonance frequency f_1 of the basic mode of setting out, and the resonance frequency f_2 of the higher mode (here secondary mode). Moreover, since both a basic mode and the higher mode have accomplished the non-supplied electric power radiation electrode 4 with the mode of double resonance and the resonance wave of the basic mode of this non-supplied electric power radiation electrode 4 double-resonates with the resonance wave of the basic mode of the feed radiation electrode 3 Resonance frequency f_1' of the basic mode of the non-supplied electric power radiation electrode 4 in the frequency near the resonance frequency f_1 of the basic mode of the feed radiation electrode 3 And since the resonance wave of the higher mode (secondary mode) of the non-supplied electric power radiation electrode 4 double-resonates with the resonance wave of the higher mode (secondary mode) of the feed radiation electrode 3 Resonance frequency f_2' of the higher mode of the non-supplied electric power radiation electrode 4 is designed so that it may become a frequency near the resonance frequency f_2 of the higher mode of the feed radiation electrode 3.

[0031] As mentioned above, by designing the feed radiation electrode 3 and the non-supplied electric power radiation electrode 4, as shown in drawing 2 (c), the double resonance state is made in the mode of both a basic mode and the higher mode, and broadband-ization of the frequency band of the signal transmission and reception in both a basic mode and the higher mode is attained.

[0032] By the way, the above-mentioned surface mount mold antenna 1 is mounted in the circuit board of a communication device, and flow connection of the feed terminal 5 is made through a matching circuit 8 at the signal supply source 9 of the circuit board. In addition, the above-mentioned matching circuit 8 may be formed as an external circuit on the circuit board of a communication device, and may be prepared as some electrode patterns on the front face of the dielectric base 2.

[0033] If a signal is supplied to the feed terminal 5 through a matching circuit 8 from the signal supply source 9 in the condition that the above-mentioned surface mount mold antenna 1 is mounted as mentioned above, while a signal will be directly supplied to the feed radiation electrode 3 from the feed terminal 5, a signal is supplied also to the non-supplied electric power radiation electrode 4 by the electromagnetic coupling. The current based on this supply signal energizes towards open end side 3b towards end side of non-supplied electric power radiation electrode 4 4b to open end side 4a, respectively from end side of feed radiation electrode 3 3a. Thereby, the feed radiation electrode 3 and the non-supplied electric power radiation electrode 4 resonate, and transmission and reception of a signal are performed. In addition, since the surface mount mold antenna 1 shown in this drawing 1 (a) is a non-grand mounting type thing, this surface mount mold antenna 1 will be mounted in the non-grand field in the circuit board of a communication device.

[0034] With the dotted line, distribution of voltage is shown for the current distribution on the current path of the common radiation electrode to drawing 3 by the continuous line for every mode again, respectively. In this drawing 3, it corresponds at the edge (at the example shown in drawing 1 (a), it is an open end) of an opposite hand, respectively with the above-mentioned signal supply [in / again / edge / A / to the edge by the side of signal supply of the feed radiation electrode 3 or the non-supplied electric power radiation electrode 4 / in B edge / the feed radiation electrode 3 or the non-supplied electric power radiation electrode 4] side.

[0035] As shown in this drawing 3, the current distribution and distribution of voltage of a basic mode or the higher mode (secondary mode and 3rd mode) have characteristic distribution for every mode, respectively. Moreover, the maximum resonance current field P (P1) which contains the maximum current section I_{max} from which the resonance

current of the basic mode of the radiation electrodes 3 and 4 serves as extremal value, for example is located in the edge by the side of the signal supply on the current path of the radiation electrodes 3 and 4. moreover, the maximum resonance current field P containing the maximum current section I_{max} from which the resonance current in the secondary mode of the radiation electrodes 3 and 4 serves as extremal value (P2) can be set on the current path of the radiation electrodes 3 and 4 -- the locations of the maximum resonance current field P differ mutually for every mode so that it may say that it is mostly located in a center section.

[0036] this invention person has noticed that the resonance frequency in each mode can be changed in the condition of having made it becoming independent of the resonance frequency in other modes by changing locally the inductance component of the maximum resonance current field P in each above-mentioned mode.

[0037] Then, the field X shown in drawing 1 used as the maximum resonance current field P of the basic mode of the feed radiation electrode 3 (P1) in this 1st example of an operation gestalt The maximum resonance current field P in the secondary mode of the feed radiation electrode 3 (P2), and the becoming field W The maximum resonance current field P of the basic mode of the non-supplied electric power radiation electrode 4 (P1), and the becoming field Z To the maximum resonance current field P in the secondary mode of the non-supplied electric power radiation electrode 4 (P2), and the becoming field Y Respectively, in this 1st example of an operation gestalt, the pattern 10 (10a, 10b, 10c, 10d) for correction of the serial inductance component which is the most characteristic pattern for resonance frequency adjustment was formed.

[0038] As shown in drawing 1, two or more hole patterns 11 arrange mutually the patterns 10a, 10b, 10c, and 10d for correction of each above-mentioned serial inductance component through spacing, and they consist of this 1st example of an operation gestalt, respectively.

[0039] In this 1st example of an operation gestalt, the electric length of the hit by unit length is long rather than the field of others [field / in which the pattern 10 for correction of the above-mentioned serial inductance component was formed]. If it puts in another way, in accordance with the current path in both, as for the above-mentioned feed radiation electrode 3 and the non-supplied electric power radiation electrode 4, electric merit's long field and electric merit's short field are established in the serial by turns.

[0040] The equal circuit of the feed radiation electrode 3 with which the pattern 10 for correction of the above-mentioned serial inductance component was formed, or the non-supplied electric power radiation electrode 4 is shown in drawing 1 (b). L1 expresses with this drawing 1 (b) the inductance component of the pattern 10 for correction of the above-mentioned serial inductance component formed in the maximum resonance current field (P1) (Z) P X, i.e., field, of a basic mode of the feed radiation electrode 3 (or non-supplied electric power radiation electrode 4). L2 expresses the inductance component of the field inserted into the above-mentioned field X (Z) of the feed radiation electrode 3 (or non-supplied electric power radiation electrode 4), and field W (Y). L3 expresses the inductance component of the pattern 10 for correction of the above-mentioned serial inductance component formed in the maximum resonance current field P (P2) of the higher mode of the feed radiation electrode 3 (or non-supplied electric power radiation electrode 4), i.e., field W, (Y). L4 expresses the inductance component of the field by the side of an open end from above-mentioned field [of the feed radiation electrode 3 (or non-supplied electric power radiation electrode 4)] W (Y). Moreover, C1 and C2 express the capacity component between the feed radiation electrode 3 (or non-supplied electric power radiation electrode 4) and a gland, respectively, and R1 and R2 express the flow resistance component, respectively.

[0041] By cutting the pattern 10 for correction of the above-mentioned serial inductance component, for example (trimming), and carrying out adjustable [of the inductance component of this pattern 10 for correction], the electric length of the hit by the unit length of the field in which the pattern 10 for correction is formed changes in the direction which becomes long. The pattern 10 for correction of this to the above-mentioned serial inductance component is equivalent to electric merit's pattern for correction.

[0042] The surface mount mold antenna 1 in this 1st example of an operation gestalt is constituted as mentioned above. Below, an example of the frequency regulation technique in the surface mount mold antenna 1 of this 1st example of an operation gestalt is explained. for example, when having shifted in the direction where the resonance frequency f_1 of the basic mode of the feed radiation electrode 3 is higher than the frequency of setting out Pattern 10a for correction of the serial inductance component formed in the maximum resonance current field P X, i.e., field, of a basic mode is cut selectively. The serial inductance component of the pattern 10a for correction is raised locally, electric merit is lengthened and this lowers him towards the frequency of setting out of the resonance frequency f_1 of the above-

mentioned basic mode.

[0043] As shown in drawing 4 , specifically, cut clearance of the field a1 in pattern 10a for correction of a serial inductance component, a field a2, and the field a3 is carried out gradually in order (). or -- a field -- a -- one -- ' -- a field -- a -- two -- ' -- a field -- a -- three -- ' -- order -- gradual -- a cut -- clearance -- carrying out -- ** -- saying -- as -- Cut the above-mentioned pattern 10 for correction in the direction which forms slitting so that a MIANDA-like pattern may be formed selectively, and the inductance component of this pattern 10 for correction is gradually raised to it (lengthening electric merit gradually). The resonance frequency f1 of a basic mode is gradually turned and lowered to the frequency of setting out. In addition, in this 1st example of an operation gestalt, as shown in drawing 4 , the notching 12 to show the starting position and the cut direction of the cut in the case of frequency regulation in the pattern 10 for correction of a serial inductance component is formed. By this notching 12, the operator of frequency regulation can prevent mistaking the sequence of a cut, and can perform suitable frequency tuning.

[0044] Moreover, pattern 10a for correction of a serial inductance component is cut selectively, and the current path is made thin, and electric merit is lengthened and you may make it raise the inductance component of pattern 10a for correction of a serial inductance component, and lower him in the direction shown in the dotted-line arrow head E of drawing 4 towards the frequency of setting out of the resonance frequency f1 of a basic mode by this.

[0045] The inductance component of pattern 10a for correction of a serial inductance component is raised locally as mentioned above, electric merit is lengthened, the resonance frequency f1 of a basic mode is lowered, and it is made in agreement with the frequency of setting out. In the case of the frequency regulation of the resonance frequency f1 of this basic mode, the effect of that frequency regulation hardly attains to the resonance frequency of the higher mode. For this reason, frequency regulation can be performed like the above in the condition of having made the resonance frequency f1 of a basic mode becoming independent of the resonance frequency f2 of the higher mode, without changing the resonance frequency f2 of the higher mode.

[0046] feed -- radiation -- an electrode -- three -- two -- order -- the mode -- resonance frequency -- f -- two ---less -- feed -- radiation -- an electrode -- four -- a basic mode -- resonance frequency -- f -- one -- ' -- two -- order -- the mode -- resonance frequency -- f -- two -- ' -- setting out -- a frequency -- being high -- a direction -- shifting -- **** -- the time -- **** -- the above -- the same -- carrying out -- Or 10d is cut selectively. pattern 10for correction b of the serial inductance component currently formed in the maximum resonance current field P in the mode for frequency regulation (that is, the field W, Z, or Y), or 10c -- The serial inductance component of the pattern 10 for correction is raised locally, electric merit is lengthened and this lowers him towards the frequency of setting out of the resonance frequency for frequency regulation. Thus, it can be made in agreement with the frequency of setting out of the resonance frequency for frequency regulation.

[0047] In the case of the frequency regulation of f2' as well as the frequency regulation of the resonance frequency f1 of the above-mentioned basic mode, the resonance frequency in other modes can adjust the resonance frequency in each mode in the above-mentioned resonance frequency f2, f1', and the condition of having made it becoming independent.

[0048] In addition, of course, the notching 12 currently formed in pattern 10a for correction of the above-mentioned serial inductance component and the same notching are formed also in the patterns 10b, 10c, and 10d for correction of a serial inductance component.

[0049] moreover, when each resonance frequency f1 and f2 in the basic mode of the feed radiation electrode 3 and the secondary mode has shifted in the direction lower than both the frequencies of setting out By cutting open end 3b of the feed radiation electrode 3, extending spacing between this open end 3b and fixed electrode 6a, and making small capacity between open end 3b and a fixed electrode 6 Capacity between open end 3b and a gland is made small, and each resonance frequency f1 and f2 in the above-mentioned basic mode and the secondary mode is raised [both] towards the frequency of setting out.

[0050] the above -- the same ---less -- feed -- radiation -- an electrode -- four -- a basic mode -- two -- order -- the mode -- each -- resonance frequency -- f -- one -- ' -- f -- two -- ' -- both -- setting out -- a frequency -- being low -- a direction -- shifting -- **** -- the time -- **** -- Open end 4a of the non-supplied electric power radiation electrode 4 for example, by cutting in the direction of the arrow head F shown in drawing 1 (a), and shortening the non-supplied electric power radiation electrode 4 an open end -- four -- a -- a fixed electrode -- six -- b -- six -- c -- between -- capacity -- small -- carrying out -- an open end -- four -- a -- a gland -- between -- capacity -- small -- carrying out -- thereby ---less -- feed -- radiation -- an electrode -- four -- a basic mode -- two -- order -- the mode -- each -- resonance

frequency -- f -- one -- ' -- f -- two -- ' -- both -- ** -- setting out -- a frequency -- turning -- raising . In addition, the open ends 3b and 4a of the feed radiation electrode 3 or the non-supplied electric power radiation electrode 4 function as a pattern for capacity adjustment in this way.

[0051] the above frequency regulation -- carrying out -- the resonance frequency f1 in each mode of the feed radiation electrode 3 and the non-supplied electric power radiation electrode 4, f1', and f2 and f2 -- ' -- all -- the frequency of setting out -- about -- it can be made to do one

[0052] The maximum resonance current field P of a basic mode (field X) and the maximum resonance current field P of the higher mode (field W) on the current path of the feed radiation electrode 3 [according to this 1st example of an operation gestalt] In the maximum resonance current field P of a basic mode (field Z) and the maximum resonance current field P of the higher mode (field Y) on the current path of the non-supplied electric power radiation electrode 4, the pattern 10 for correction of a serial inductance component (electric merit's pattern for correction), respectively as a pattern for resonance frequency adjustment It formed. this -- a configuration -- having had -- things -- feed -- radiation - - an electrode -- three -- a basic mode -- resonance frequency -- f -- one -- the higher mode -- resonance frequency -- f - - two -- less -- feed -- radiation -- an electrode -- four -- a basic mode -- resonance frequency -- f -- one -- ' -- the higher mode -- resonance frequency -- f -- two -- ' -- process tolerance -- a problem -- setting out -- a frequency -- from -- shifting -- **** -- the time -- **** -- The pattern 10 for correction of the serial inductance component currently formed in the maximum resonance current field P in the mode for [the] frequency regulation is cut selectively, the serial inductance component of this pattern 10 for correction is changed locally, and it carries out adjustable [of the electric length], The technique of making [technique] open end capacity small and raising resonance frequency can be used together, and, thereby, it can be made in agreement with the frequency of setting out of the resonance frequency in the mode for frequency regulation.

[0053] Moreover, in this 1st example of an operation gestalt, since the pattern 10 for resonance frequency adjustment is formed like the above, the location cut in the case of frequency regulation is known clearly. Moreover, since the suitable location for frequency regulation can be cut certainly and frequency regulation can be performed, even if it is not those who gained the experience, frequency regulation can be performed easily and promptly, the cutback of adjustment process expense can be aimed at, and it can tie to the cost cut of the surface mount mold antenna 1. Furthermore, it becomes possible to realize automation of frequency regulation, and the further cost cut is possible.

[0054] Furthermore, in this 1st example of an operation gestalt, since the pattern 10 for correction of a serial inductance component is formed in the maximum resonance current field P in each mode like the above It can be made to be able to change in the condition of having changed only the resonance frequency for frequency regulation, that is, having made the resonance frequency for frequency regulation becoming independent of other resonance frequency in the case of frequency regulation, without changing resonance frequency other than for frequency regulation, and can be made in agreement with the frequency of setting out. Frequency regulation of the surface mount mold antenna 1 is performed simply and efficiently by this, and can raise the mass production nature of the surface mount mold antenna 1 by it. Moreover, it can double with a precision sufficient in the frequency of setting out of each above-mentioned resonance frequency.

[0055] Therefore, by having a characteristic configuration in this 1st example of an operation gestalt, and performing frequency regulation peculiar to the above, it will be cheap and the surface mount mold antenna 1 excellent in the antenna property can be offered.

[0056] Below, the 2nd example of an operation gestalt is explained. In addition, in explanation of this 2nd example of an operation gestalt, the same sign is given to the same component as said 1st example of an operation gestalt, and duplication explanation of that intersection is omitted.

[0057] The surface mount mold antenna 1 of said 1st example of an operation gestalt is a grand mounting type thing with a configuration as shows the surface mount mold antenna of this 2nd example of an operation gestalt to drawing 5 to being a non-grand mounting type thing. In addition, in drawing 5 , top-face 2a of the dielectric base 2, side-face 2b, and each surface type voice (2c and 2d) are illustrated according to the expansion condition like said drawing 1 .

[0058] As shown in drawing 5 , contiguity arrangement of the feed radiation electrode 3 and the non-supplied electric power radiation electrode 4 of each other is carried out through spacing at top-face 2a of the dielectric base 2. Moreover, while contiguity arrangement of the feed terminal 5 and the grand jumper 7 is carried out through spacing at side-face 2c of the dielectric base 2, the matching circuit 8 which makes free passage connection is formed in the above-mentioned feed terminal 5. Free passage connection of the signal supply side edge section 3a of the feed

radiation electrode 3 is made at the above-mentioned feed terminal 5, and free passage connection of the signal supply side edge section 4b of the non-supplied electric power radiation electrode 4 is made at the above-mentioned grand jumper 7. In addition, in the example shown in drawing 5, although the matching circuit 8 was formed on the front face of the dielectric base 2, it may omit the matching circuit 8 of the surface mount mold antenna 1, and may establish a matching circuit 8 in the circuit board of a communication device.

[0059] Furthermore, open end 3b by which expanding formation was carried out from the above-mentioned feed radiation electrode 3 is formed in side-face 2b of the dielectric base 2, and opposite arrangement of the fixed electrode 6 is carried out through spacing at this open end 3b. Open end 4a by which expanding formation was carried out from the above-mentioned non-supplied electric power radiation electrode 4 is formed in 2d of side faces of the dielectric base 2 further again, and opposite arrangement of the fixed electrode 6 is carried out through spacing like the above at the open end 4a.

[0060] Furthermore, the breakthrough 14 penetrated on 2d of side faces from side-face 2b is formed in the dielectric base 2 shown in this drawing 5. Lightweight-ization of the dielectric base 2 can be attained by forming this breakthrough 14. Moreover, a gland and a radiation inter-electrode effective dielectric constant fall, electric-field concentration is eased, and broadband-izing and high interest profit-ization can be realized.

[0061] Also in this 2nd example of an operation gestalt like the example of an operation gestalt of the above 1st The resonance wave of the basic mode of the non-supplied electric power radiation electrode 4 double-resonates with the resonance wave of the basic mode of the feed radiation electrode 3. Moreover, the resonance wave of the higher mode of the non-supplied electric power radiation electrode 4 will be designed so that it may double-resonate with the resonance wave of the higher mode of the feed radiation electrode 3, and it will be in the double resonance state in the mode of both a basic mode and the higher mode, and broadband-ization of the frequency band of signal transmission and reception is attained.

[0062] Moreover, as for the above-mentioned feed radiation electrode 3, the signal from the signal supply source 9 is directly supplied to a signal by reception and the non-supplied electric power radiation electrode 4 by the electromagnetic coupling from the feed terminal 5 like said 1st example of an operation gestalt. The current based on the supply signal flows towards open end 3b towards end side of non-supplied electric power radiation electrode 4 4b to open end 4a, respectively from end side of feed radiation electrode 3 3a.

[0063] The field X which is the maximum resonance current field P of the basic mode [also set for this 2nd example of an operation gestalt, and] on the current path of the feed radiation electrode 3 (P1) like the example of an operation gestalt of the above 1st The field W which is the maximum resonance current field P of the higher mode (P2), and the field Z which is the maximum resonance current field P of the basic mode on the current path of the non-supplied electric power radiation electrode 4 (P1) The pattern 10 for correction of the serial inductance component which is a pattern for frequency regulation (electric merit's pattern for correction) is formed in the field Y which is the maximum resonance current field P of the higher mode (P2), respectively.

[0064] The surface mount mold antenna 1 shown in this 2nd example of an operation gestalt is constituted as mentioned above. In case frequency regulation of such a surface mount mold antenna 1 is performed By cutting selectively the pattern 10 for correction of the serial inductance component currently formed in the maximum resonance current field P in the mode for frequency regulation, cutting it deeply like the example of an operation gestalt of the above 1st, and making the slitting depth of 13 deep The inductance component of the pattern 10 for correction can be raised, and the resonance frequency in the mode for frequency regulation (lengthening electric merit) can be lowered.

[0065] moreover -- feed -- radiation -- an electrode -- three -- an open end -- three -- b -- or ---less -- feed -- radiation -- an electrode -- four -- an open end -- four -- a -- cutting -- an open end -- three -- b -- four -- a -- a gland -- between -- capacity -- lowering -- things -- feed -- radiation -- an electrode -- three -- a basic mode -- the higher mode -- both -- resonance frequency -- f -- one -- f -- two -- or ---less -- feed -- radiation -- an electrode -- four -- a basic mode -- the higher mode -- both -- resonance frequency -- f -- one -- ' -- f -- two -- ' -- respectively -- coincidence -- it can raise .

[0066] Also in this 2nd example of an operation gestalt, the same outstanding effectiveness as the example of an operation gestalt of the above 1st can be done so.

[0067] Below, the 3rd example of an operation gestalt is explained. In addition, in explanation of this 3rd example of an operation gestalt, the same sign is given to the same component as said each example of an operation gestalt, and duplication explanation of that intersection is omitted.

[0068] The 3rd example of an operation gestalt of a surface mount mold antenna is shown in drawing 6 . Also in this drawing 6 , top-face 2a of the dielectric base 2, side-face 2b, and each surface type voice (2c and 2d) are shown according to the expansion condition like said drawing 1 and drawing 5 .

[0069] The surface mount mold antenna 1 shown in this 3rd example of an operation gestalt is the thing of a non-grand mounting type direct excitation mold, and as shown in drawing 6 , the feed radiation electrode 3 and two non-supplied electric power radiation electrodes 4A and 4B of each other are formed through spacing, and it grows into the front face of the dielectric base 2. The above-mentioned feed radiation electrode 3 has the almost same configuration as the feed radiation electrode 3 shown in said drawing 1 , and the above-mentioned non-supplied electric power radiation electrodes 4A and 4B of each other are formed through spacing on the right-hand side of [electrode / 3 / in top-face 2a of the dielectric base 2 / feed radiation] drawing.

[0070] the above ---less -- feed -- radiation -- an electrode -- four -- A -- four -- B -- each -- a basic mode -- resonance frequency -- f -- one -- ' -- f -- one -- ' -- ' -- mutual -- small -- differing -- and the frequency near the resonance frequency f1 of the basic mode of the feed radiation electrode 3 -- accomplishing -- **** -- the resonance wave of each basic mode of the above-mentioned non-supplied electric power radiation electrodes 4A and 4B -- the resonance wave of the basic mode of the feed radiation electrode 3, and the three-fold double resonance state -- making . moreover -- the same -- the above ---less -- feed -- radiation -- an electrode -- four -- A -- four -- B -- each -- the higher mode -- resonance frequency -- f -- two -- ' -- f -- two -- ' -- ' -- mutual -- small -- differing -- and the frequency near the resonance frequency f2 of the higher mode of the feed radiation electrode 3 -- accomplishing -- **** -- the resonance wave of each higher mode of the above-mentioned non-supplied electric power radiation electrodes 4A and 4B -- the resonance wave of the higher mode of the feed radiation electrode 3, and the three-fold double resonance state -- making . Thus, much more broadband-ization of the frequency band of signal transmission and reception of a basic mode and the higher mode can be attained by making the three-fold double resonance state.

[0071] Free passage connection of one one end each of the above-mentioned non-supplied electric power radiation electrodes 4A and 4B was made common to the grand jumper 7 formed in side-face 2c, and the other end side of each nothing feed radiation electrodes 4A and 4B has accomplished with the open end, respectively. It changes with the configuration that a current flows towards an open end from the end side which is open for free passage to the grand jumper 7 in each above-mentioned nothing feed radiation electrodes 4A and 4B. The field Z which is the maximum resonance current field P of the basic mode on the current path of each nothing feed radiation electrodes 4A and 4B (P1), and Z', The pattern 10 for correction of the serial inductance component which is a pattern for resonance frequency adjustment (electric merit's pattern for correction) is formed in the field Y which is the maximum resonance current field P of the higher mode (P2), and Y', respectively.

[0072] Also in this 3rd example of an operation gestalt, since the pattern 10 for correction of the same serial inductance component as each above-mentioned example of an operation gestalt (electric merit's pattern for correction) was formed on each current path of the feed radiation electrode 3 and the non-supplied electric power radiation electrodes 4A and 4B Like each above-mentioned example of an operation gestalt The pattern 10 for correction of the serial inductance component currently formed in the maximum resonance current field P in the mode for [in the feed radiation electrode 3, non-supplied electric power radiation electrode 4A, or non-supplied electric power radiation electrode 4B] frequency regulation is cut. By changing the inductance component of this pattern 10 for correction, and lengthening electric merit, the resonance frequency for frequency regulation can be made in agreement with the frequency of setting out in the condition of having made it becoming independent of the resonance frequency in other modes.

[0073] Moreover, when lower than both the frequencies of setting out, each resonance frequency of each basic mode of the feed radiation electrode 3 and the non-supplied electric power radiation electrodes 4A and 4B and the higher mode can cut the open end of the feed radiation electrode 3 for frequency regulation, and the non-supplied electric power radiation electrodes 4A and 4B, can raise simultaneously each resonance frequency of a basic mode and the higher mode both, and can be made in agreement with the frequency of setting out.

[0074] Also in this 3rd example of an operation gestalt, the same outstanding effectiveness as said each example of an operation gestalt can be done so.

[0075] Below, the 4th example of an operation gestalt is explained. This 4th example of an operation gestalt shows an example of a communication device. As the communication device in this 4th example of an operation gestalt is shown in drawing 7 , it is pocket mold telephone and the circuit board 22 is built in in the case 21 of this pocket mold

telephone 20. As shown in drawing 7 , the sending circuit 23, the receiving circuit 24, and the transceiver switch circuit 25 which are a signal supply source are formed in this circuit board 22.

[0076] It being characteristic in the communication device of this 4th example of an operation gestalt is that the surface mount mold antenna 1 which equipped the above-mentioned circuit board 22 with the characteristic configuration shown in each above-mentioned example of an operation gestalt is mounted. Flow connection of this surface mount mold antenna 1 is made through the transceiver switch circuit 25 in the above-mentioned sending circuit 23 and the receiving circuit 24. In this pocket mold telephone 20, transceiver actuation of a signal is smoothly performed by switch actuation of the above-mentioned transceiver switch circuit 25.

[0077] Since the double resonance type surface mount mold antenna as [shown in the pocket mold telephone 20 at each above-mentioned example of an operation gestalt] was equipped according to this 4th example of an operation gestalt The frequency band of signal transmission and reception can be broadband-ized. Moreover, the surface mount mold antenna 1 Since each resonance frequency of the feed radiation electrode 3 or the non-supplied electric power radiation electrode 4 is mostly in agreement with the frequency of setting out with frequency regulation, a communication device with the high dependability of an antenna property can be offered.

[0078] In addition, this invention is not limited to each above-mentioned example of an operation gestalt, and can take the gestalt of various operations. For example, although two or more hole patterns 11 carried out contiguity arrangement and were formed through spacing, the pattern for resonance-frequency adjustment (pattern 10 for correction of a serial inductance component (electric merit's pattern for correction)) shown in each above-mentioned example of an operation gestalt may be replaced with the pattern for the resonance frequency adjustment, and may form the pattern of the shape of MIANDA as shown in drawing 8 (a) as a pattern for resonance frequency adjustment, for example. Moreover, as shown in drawing 8 (b) and (c), it is good also as a configuration make the cut for frequency regulation easy to make some MIANDA-like patterns thicker than other parts, and to perform.

[0079] Moreover, if the capacity component C is formed in juxtaposition at the current path 15 as shown in drawing 9 (b), as shown in drawing 9 (c), it will be it in an equivalent condition to have added the inductance component L at the serial at the current path 15. The pattern for correction (electric merit's pattern for correction) of a serial inductance component as shown in drawing 9 (a) may be formed as a resonance frequency adjustment pattern, using this. that is, when considering as the configuration which forms the electrode 16 for capacity addition near the maximum resonance current field P in each mode on the current path of the feed radiation electrode 3 or the non-supplied electric power radiation electrode 4, and adds a serial inductance component to the above-mentioned maximum resonance current field P of a current path equivalent and performing frequency regulation The radiation electrode section 17 which counters the above-mentioned electrode 16 for capacity addition or this electrode 16 is cut. By what the capacity between the above-mentioned maximum resonance current field P and the electrode 16 for capacity addition is changed, and the above-mentioned inductance component is changed for (electric merit is changed), frequency regulation may be performed like each above-mentioned example of an operation gestalt.

[0080] In each above-mentioned example of an operation gestalt, furthermore, the pattern for resonance frequency adjustment of the basic mode of the feed radiation electrode 3 and the pattern for resonance frequency adjustment of the higher mode, Although all of the pattern for resonance frequency adjustment of the basic mode of the non-supplied electric power radiation electrode 4 and the pattern for resonance frequency adjustment of the higher mode were formed They are not formed if needed and do not need to form all the patterns for each resonance frequency adjustment of the basic mode of the above-mentioned feed radiation electrode 3 and the non-supplied electric power radiation electrode 4, and the higher mode.

[0081] Furthermore, although it was the configuration that the double resonance state was made in the mode of both a basic mode and the higher mode, in each above-mentioned example of an operation gestalt as shown in drawing 2 (c) For example, as one of the basic mode of the non-supplied electric power radiation electrode 4 and the higher modes double-resonates with the resonance wave of the basic mode of the feed radiation electrode 3, or the higher mode and it is shown in drawing 2 (a) and the continuous line C of (b) You may constitute so that only one mode of a basic mode and the higher modes may be in the double resonance state.

[0082] Furthermore, although each above-mentioned example of an operation gestalt showed the example which performs frequency regulation in the secondary mode as the higher mode, of course, frequency regulation of the higher mode more than the 3rd mode may be performed. In this case, a pattern for resonance frequency adjustment which was described above to the maximum resonance current field P in the 3rd mode on the current path of the feed radiation

electrode 3 or the non-supplied electric power radiation electrode 4 is formed.

[0083] Furthermore, although the surface mount mold antenna 1 shown in each above-mentioned example of an operation gestalt was the thing of direct excitation $\lambda/4$ resonance molds, this invention may be applied to the thing of a capacity feed mold, and may be applied also to the antenna of a reverse female mold, and it can apply it to a surface mount mold antenna various type.

[0084]

[Effect of the Invention] Since one or more patterns in the pattern for resonance frequency adjustment of the basic mode of a feed radiation electrode, the pattern for resonance frequency adjustment of the higher mode, and the pattern for resonance frequency adjustment in the mode double resonance of a non-supplied electric power radiation electrode are formed according to this invention The cut location for performing frequency regulation becomes clear, and even if it is not those who gained the experience, it becomes possible to cut the suitable location for frequency regulation and to perform frequency regulation simply.

[0085] Especially If the pattern for resonance frequency adjustment in each mode is one of those which it was formed in the maximum resonance current field in the mode in which it corresponds on the current path in a feed radiation electrode or a non-supplied electric power radiation electrode, respectively, and have been accomplished with the pattern for correction of the serial inductance component of this field (electric merit's pattern for correction) When the resonance frequency in the mode with the maximum resonance current field in which the pattern for correction of the serial inductance component is formed has shifted from the frequency of setting out By cutting selectively the pattern for correction of the serial inductance component, changing a serial inductance component, and carrying out adjustable [of the electric merit], frequency regulation made in agreement with the frequency of setting out of the resonance frequency for frequency regulation can be performed.

[0086] Thus, since the resonance frequency for frequency regulation can be changed in the condition of having made it becoming independent of other resonance frequency when changing the inductance component of the maximum resonance current field in the mode for frequency regulation and changing the resonance frequency for frequency regulation, easily, it is a short time and, moreover, frequency regulation can be performed with a sufficient precision. Therefore, frequency regulatory cost can be reduced and the cost cut of a surface mount mold antenna is possible. Moreover, since it becomes easy to realize automation of frequency regulation, the further cost cut is expected.

[0087] By this, the property and mass production nature of a surface mount mold antenna can be raised, and the surface mount mold antenna excellent in the antenna property can be offered cheaply.

[0088] The end side of a current path accomplishes a feed radiation electrode with an open end. Each resonance frequency of the basic mode of a feed radiation electrode and the higher mode The case of being lower than both the frequencies of setting out, The end side of a current path accomplishes a non-supplied electric power radiation electrode with an open end. Each resonance frequency of the basic mode of a non-supplied electric power radiation electrode and the higher mode when lower than both the frequencies of setting out If it is in some which cut the open end of the above-mentioned feed radiation electrode or a non-supplied electric power radiation electrode, make capacity between an open end and a gland small, and raise each resonance frequency of the basic mode of a feed radiation electrode or a non-supplied electric power radiation electrode, and the higher mode both towards the frequency of setting out Only by cutting the open end of a feed radiation electrode or a non-supplied electric power radiation electrode, since it can be made to change towards the frequency of setting out of the resonance frequency of both a basic mode and the higher mode, frequency regulation can be performed efficiently.

[0089] If it is in some in which a means to cut the pattern for correction of a serial inductance component selectively, and to change the inductance component of this pattern for correction gradually is formed, the resonance frequency for frequency regulation can be gradually changed to the frequency of setting out using the means. Since the trouble of adjusting the amount of cuts of a pattern based on an experience is lost in case such frequency regulation is performed, frequency regulation can be performed still more easily and the mass production nature of a surface mount mold antenna can be raised further.

[0090] By forming the surface mount mold antenna in which frequency regulation peculiar to the above is possible, it will be cheap to a communication device and it can be provided with the reliable communication device of an antenna property.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the explanatory view showing the 1st example of an operation gestalt of the surface mount mold antenna concerning this invention.

[Drawing 2] It is the graph which shows the example of the frequency characteristics of a surface mount mold antenna.

[Drawing 3] It is the graph which shows the current distribution and distribution of voltage in a current path of a feed radiation electrode and a non-supplied electric power radiation electrode for every mode.

[Drawing 4] In case frequency regulation of the surface mount mold antenna shown in drawing 1 is performed, it is drawing for explaining the example of a cut of the pattern for correction of the serial inductance component which is a pattern for resonance frequency adjustment.

[Drawing 5] It is the explanatory view showing the 2nd example of an operation gestalt.

[Drawing 6] It is the explanatory view showing the 3rd example of an operation gestalt.

[Drawing 7] It is model drawing showing an example of the communication device concerning this invention.

[Drawing 8] It is the explanatory view showing the example of an operation gestalt of others of the pattern for correction of a serial inductance component.

[Drawing 9] Furthermore, it is the explanatory view showing the example of an operation gestalt of others of the pattern for correction of a serial inductance component.

[Description of Notations]

1 Surface Mount Mold Antenna

2 Dielectric Base

3 Feed Radiation Electrode

4 Non-Supplied Electric Power Radiation Electrode

5 Feed Terminal

7 Grand Jumper

10 Pattern for Correction of Serial Inductance Component

11 Hole Pattern

20 Pocket Mold Telephone

[Translation done.]

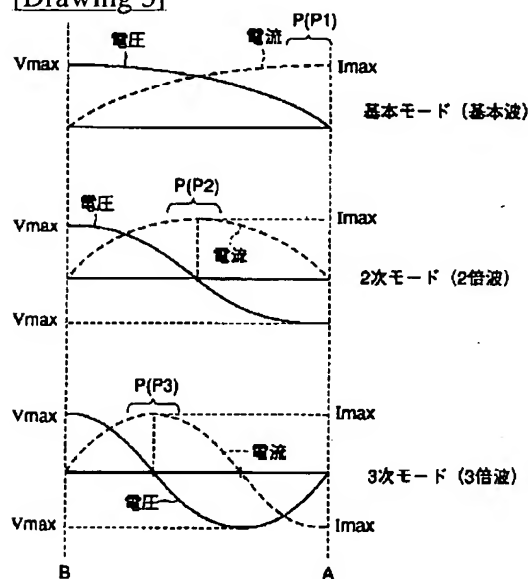
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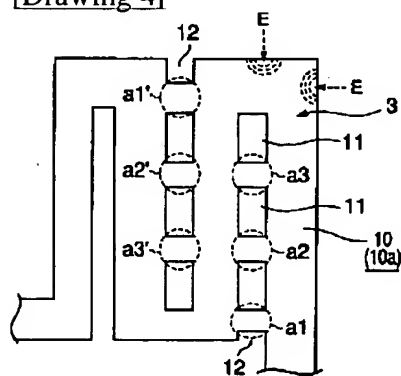
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DRAWINGS

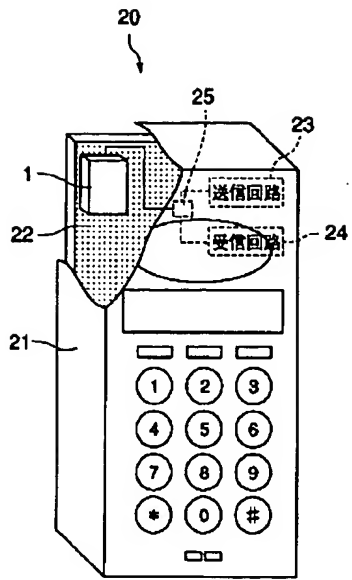
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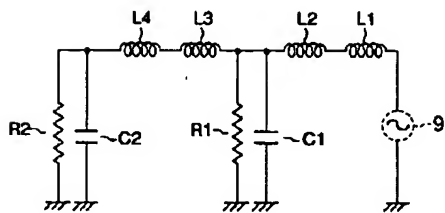
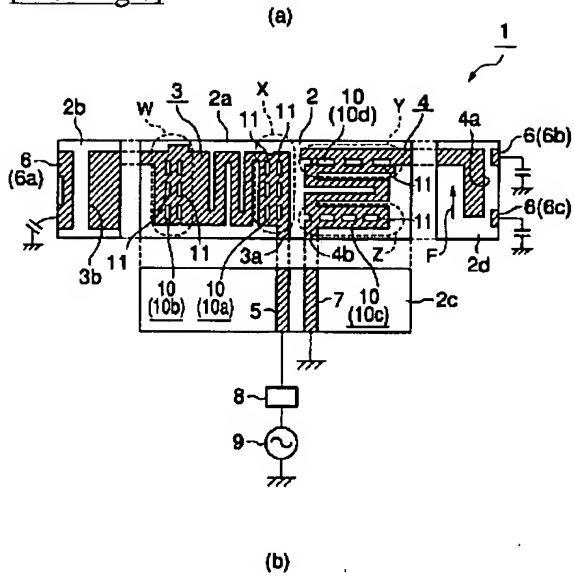
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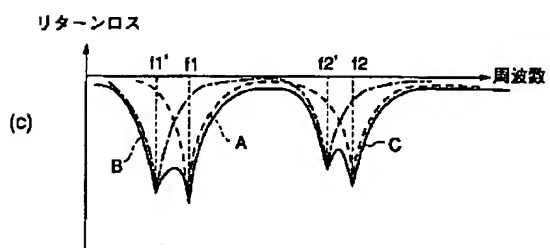
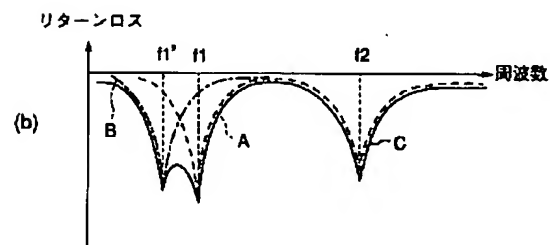
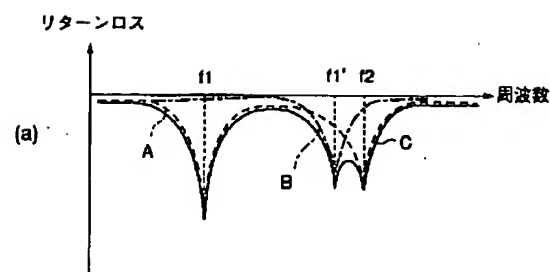
[Drawing 7]



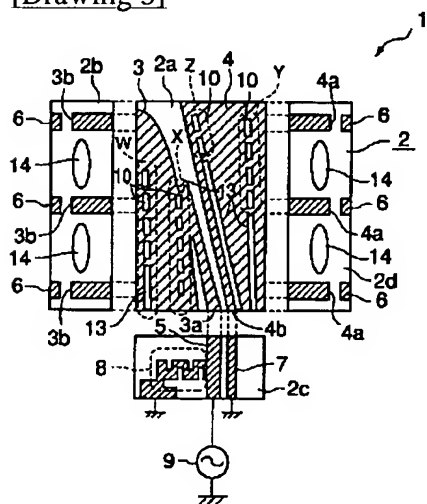
[Drawing 1]



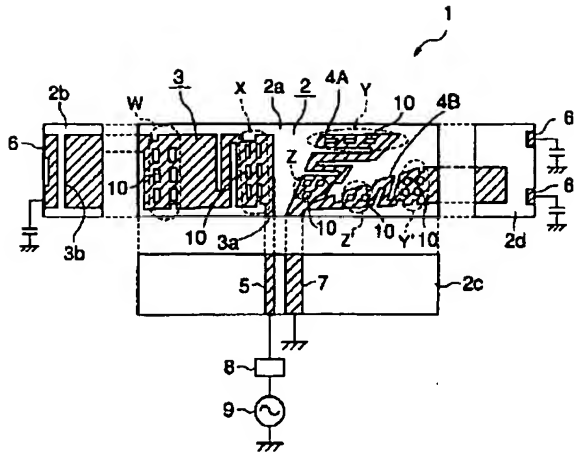
[Drawing 2]



[Drawing 5]



[Drawing 6]



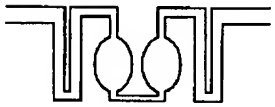
[Drawing 8]
(a)



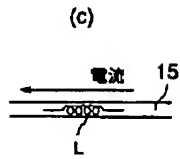
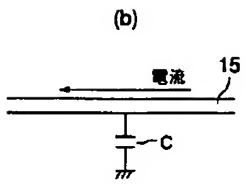
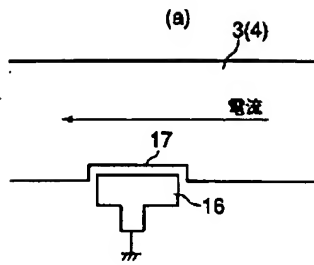
(b)



(c)



[Drawing 9]



[Translation done.]